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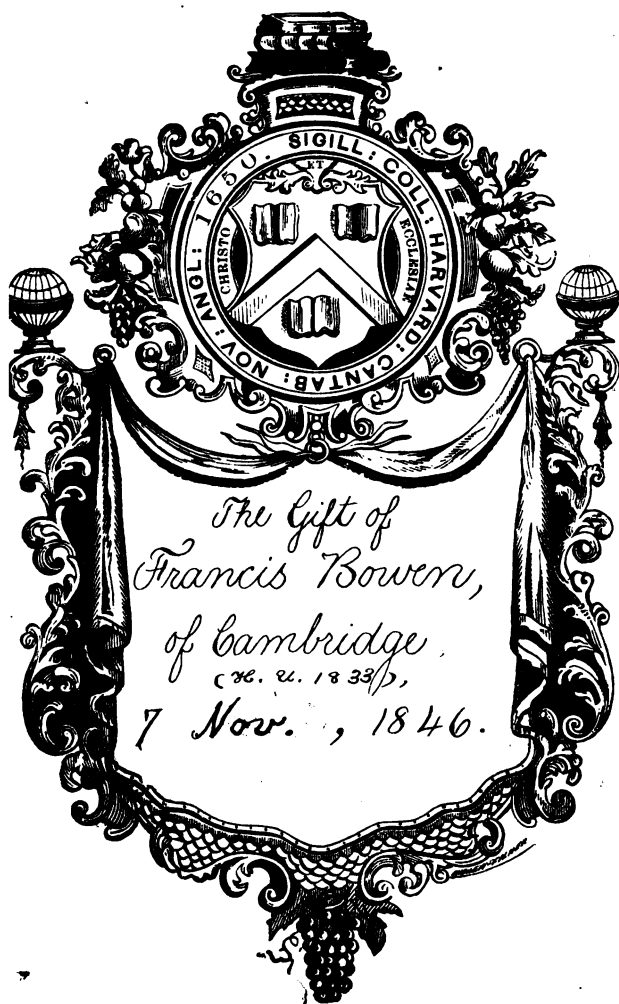
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with Respect of the Author.*

**BRIEF MEMOIR**

**EXPLANATORY OF A NEW TRACE**

**OF A**

**FRONT OF FORTIFICATION**

**IN PLACE OF**

**THE PRESENT BASTIONED FRONT.**

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**BY WM. H. CHASE,**  
**MAJOR OF ENGINEERS.**

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## MEMOIR.

"Le Problème à résoudre serait donc, de trouver un tracé qui, par lui-même, et abstraction faite des accidens du terrain, déroberait toutes ses parties à l'action du ricochet et de l'enfilade: et la solution de ce problème, qui n'est peut-être pas impossible, est encore toute entière à trouver."—BOUSMARD, ESSAI DE FORTIFICATION Liv. I—70.

MANY masters have endeavored to render the art of Fortification in practice what it is defined to be: "L'art de mettre, par des travaux exécutés à l'avance, le faible en état de résister au fort et de repousser ses attaques."

Philosophic statesmen have viewed these labors with deep interest, looking to the perfection of the defence as the best regulator of international powers.

Art, helped by theory and practice, has been exhausted in the arrangement of lines and angles in the best possible manner to resist attack. But the attack remains predominant, and so it will remain as long as the artillery and the defenders of a place can be destroyed and driven from their position by the effects of *ricochet* and *enfilade*.

Those costly and magnificent structures, designed to cover a frontier or to maintain strategic points, can only be arranged (unless assisted by natural obstacles) to resist sieges, the maximum duration of which may be stated at 40 or 50 days.

Fort Adams, at Newport, which is indeed a splendid specimen of the art of fortification, whose plan was derived from the methods of the best contrivers, and whose construction involves an expenditure approaching two millions of dollars, is a work of great strength, yet this important work whose channel fronts, assisted by some auxiliary batteries, could prevent the most powerful fleet from entering the harbour, may be taken, if not prevented by existing collateral means of defence, in fifty days.

Fortunately no exterior enemy can lay siege to Fort Adams; for that work is placed in position in the midst of a population that could send forth one hundred thousand armed men in forty-eight hours to drive a sieging army into the sea.

Still as this work was designed to resist a siege, and its front of attack arranged after the best methods upon the maximum value of defence, it may properly be referred to, in order to show that the art of defence, unassisted by nature, or collateral circumstances, is presently powerless to resist successfully a regular attack by land approaches.

But whilst Newport possesses auxiliary and collateral means of defence by the circumstances of the country in which it is located, there are other points that do not possess these advantages. The island and harbour of Key West, for the defence of which, costly and extensive works are designed to be constructed, will be entirely dependent on those works for their defence against the attacks of an enemy which, possessing a naval supremacy, may lay siege to them either by land or water.

This most important point, the capture of which would be ardently sought by a naval enemy, could be taken in forty or fifty days. Its dépôts

and magazines, intended to contain a supply of coal, provisions, and munitions of war for three years, in order to resist possible blockades, being thus captured, the auxiliary works situated on the neighboring shoals in the harbor would in time be surrendered by their starving garrisons.

And thus a great position may not only be taken in a given time, but thereafter held by an enemy superior in naval means, as the *point d'appui* of his operations in the Straits of Florida and the Gulf of Mexico, affording him in many respects a position superior to that of Havana.

Considering then the feebleness of the defence as compared with the attack of places, the writer of this memoir is induced to offer remedies for the great defects existing in the modern art of defence.

It will doubtless be considered temerity in him to approach a subject believed to have been exhausted by the most eminent masters in the art. But as the problem has been offered as stated at the head of this memoir, and as its solution is perhaps not impossible, why should not an humble follower of the art be encouraged somewhat in the premises.

The author of the new trace has received encouragement in his humble efforts. Under the advice of friends, who have the independence to think for themselves and to express their opinions whether they are in agreement with an established formula or not, he has determined to offer his project to the notice of military men in this country and in Europe.

There is no profession in which the exact sciences are concerned, that exhibits so little progress in improvement as that of the Military Engineer. For one hundred and seventy-six years it has remained almost stationary.

The student is told that Vauban, and his follower and disciple Cormontaigne, have occupied the whole ground in the art of attack and defence, that their principles are predominant—that the imitators of these great men, who have proposed new systems, have entirely failed in their designs, and that the art as taught by Vauban remains unchanged in all its principles, relations and uses; and that it will probably remain so through all time.

The lecturer contents himself with the enunciation of these truths, and proceeds to indoctrinate the student accordingly. The student advances in the study of the noble art according to the formula laid down in the books. In proportion as he perfects himself in the study of the "Bastioned Fronts;" in proportion as he exhibits facility in applying principles to supposed cases of attack and defence of this Front, so is he placed, and justly too, in the order of merit in the art of Engineering.

But there is no encouragement to the student to think for himself. If he offer a new idea, or what he thinks is one, he is jeered at and referred to the preliminary lecture of the professor, and to the eternal principles of the "Bastioned Front."

If he press his proposition, the book may perhaps be opened and the formula examined. If his suggestions are found to involve only modifications of some details in the Bastioned Front they may perhaps be considered. But if they compromise and aim to destroy the principles of that old Front whose age would seem to be amongst those things entitling it to respect—the book is closed—spectacles are laid aside, and the proposer held to this admonishment, that "there is no God but God and Mahomet is his prophet!"

His success in the college depends upon his complaisance. He must possess a preëminent genius and a fearlessness of consequences if he would



continue to oppose existing dogmas, and proclaim that truth is yet to be found in matters of faith and philosophy.

Pythagoras returning from his secret mission into deep India, in vain promulgated the principles of the solar system, which he obtained from the records of science in that country. Copernicus, who revived these principles from the oblivion they had been buried in for many ages, was persecuted and endangered by bigots.

Emanuel Swedenbrough wrote in his work on Astronomy of the existence of the *seventh planet*, which Herschel *thirty years after* discovered to be true.

So in our time a Fulton was deemed an enthusiast by the enlightened savans of the world, whilst a Whitney died in want. It has ever been so with the bold and gifted investigators and the humble diggers of truth. Jeered at and despised, these patient laborers are pointed at by the passers-by, who exclaim, "look at these foolish diggers!"

The student, passing to a more enlarged field of action and in the practice of the noble art of Fortification, is necessarily and for the most part called upon to execute the designs and plans of others. Following instructions he labors diligently in the dull routine of construction and in the daily details of work. It is thought that this tread-mill part of the profession does not contribute much to the polishing of the intellect. But if, occasionally, one desires to improve himself and promote the usefulness of his profession, to contribute something to the general fund of knowledge, he has no opportunity of giving the results of his reflections to the public. His communications are made to the Engineer Bureau, where, owing to the pressure of business that branch of the war department daily sustains, there is no time afforded to consider them. There is no place, even at the military school, where series of useful experiments are made, where the value of new suggestions may be tried. There are no monthly, quarterly or annual memoirs published, in which valuable suggestions and the results of experiments may be recorded and made known. An American book has never been written on the Art of War, or on its improvement and better adaptation to the institutions and peculiar position of the United States. Foreign text books, not only centuries old, but which were issued from No. 18 *Rue des Grands Augustins*, in the year 1846, fill the shelves of our military libraries.

It would be doing injustice to many gifted and accomplished officers of the army to say that they were incompetent to contribute toward professional publications; but in the absence of any plan for those publications, and of an encouragement on the part of the Government to promote them, no opportunity is afforded by which professional propositions and discussions might be most beneficially elicited.

The writer contents himself with these preliminary remarks, which are already extended further than he intended. His desire being simply to submit the plan of the new trace to competent judges for their decision upon its merits, and he proceeds to make remarks and explanations that seem to be necessary to the understanding of the subject.

In modern fortifications there is but one system, that of Vauban; all others so called involve the principles which the great master of the art established, and are therefore mere modifications of his system.

Principles here mean that radical change in the disposition of lines and angles by which the defence was greatly increased in power and approached nearer to an equilibrium with the attack.

There is but little resemblance between the new trace and modern fortification. The points of difference are exhibited in the former by the square or parallelogramic figure;\* the flanking towers; the narrow and deep ditches; and the reliance upon the body of the place to resist attack without the aid of advanced works.

The clothing of walls with wrought iron bars to prevent breaches being made, thus depriving the attack of its greatest advantage; the arrangement of the towers and cavaliers so as to present traverses against enfilade and ricochet to other parts of the work; the protection afforded by a system of blindage for the towers, cavaliers and upper parapet of curtain, by which their guns are concealed from ricochet; the guns of large calibre thus protected and bearing on the capitals by which the establishment of breaching and counter batteries is prevented; and the destructive cannonry that may be directed against the sieger's works even at the distance of 600 yards, exhibit a radical change in the modern arrangements of defence. If this change be approved and adopted by the Engineer, a new system is claimed to be established.

The arrangement of auxiliary works, defensive in themselves in such a manner as to make them serve as traverses to other parts of the main work is most important, and is only to be effected by the concentration of those works within the enceinte: That is, to dispense with all exterior works save the reversed batteries in casemates under counterscarp salient, and substitute the high towers made cannon proof; the commanding cavaliers with their guns secure from ricochet; and the upper parapet with its blindage. This arrangement cannot fail to attract attention by its simplicity and the great strength and efficiency it affords.

The advantages of the cumulative works over exterior works are obvious. The exterior works after a little time are taken by the siegers and afford facilities in the final reduction of the corps du place. On the contrary the cumulative works cannot be taken until the enceinte itself is in possession of the assailant; and even then the towers and cavaliers are held as strong citadels.

It is thought then, that with these advantages, as well as others herein enumerated, *the defence is made superior to the attack*; and that an attack on land will become like that by water, one of cannonade and bombardment, in which the superiority is on the side of the defence arising from well arranged batteries supplied with heavy ordnance.

It is in place here to offer in the form of a journal the author's ideas of the probable attack and defence of a work arranged after his method. A single front for attack is selected. The operations against one front involve everything that would be done if every front were simultaneously attacked. The object of the siegers is the destruction, if possible, of the blindage of the towers, cavaliers, and curtains. The fire of the batteries is directed so that the shot and shells may strike the crest of parapet of those parts of the work, or passing over them, strike the adjoining parts. If as it is supposed the siegers are prevented from advancing beyond the second parallel at the distance of 600 yards from the place, unless at an enormous sacrifice of men, and confine their operations to that of bom-

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\* It does not follow that all works on the new trace should be constructed on a square or parallelogramic figure. This figure has been adopted for illustration as combining efficiency of defence with economy in construction, and, in most cases, as being adapted to the circumstances to be considered in respect of the defence.

hardment, they would probably envelope two or more fronts, if the locale of the works permitted.

The journal contains only the leading measures of attack. It is supposed that everything is resorted to that may insure the success of the siege. Finding that no approach could be made in the usual manner, the siegers might determine to erect batteries between the first and second parallels, to receive artillery of a calibre better adapted to meet the terrific fire of the place. If the place sieged was convenient to the sea or to facile lines of transportation, such artillery could be supplied and a new character given to the siege in which a heavy cannonade would be combined with bombardment. The result of this determined siege would depend upon the strength of the bomb and cannon proof defences of the work; the supplies of the garrison; and the amount of sacrifice that the siegers would be willing to make in order to get possession of the place. The Engineer will consider all these things, and the author therefore contents himself with the following brief journal as sufficiently illustrative of his estimate of the strength of a work arranged after his method. (See plate 3d, fig. 5.)

#### ATTACK.

##### *1st period of twenty-four hours.*

The siegers having taken the necessary precaution due to the investment proceed to open the trenches. Every thing else is done that experience teaches in similar cases. The plan of the work is known to the siegers. It is either a square or a parallelogram. The point of attack is near the capitals. There being no weak point in the work itself, the front of attack is determined by the nature of the ground in advance. The reconnoissances are directed with this view. The attack is decided to be made on two capitals of the work, the zig-zags being carried up a little to the right of the left salient of the work, and to the left of the right salient. The object being to avoid the direct fire of the right and left flanks of the towers and cavaliers of collateral fronts, and half the oblique fire of the curtains of those fronts. (See fig. plate.)

If the country will admit, every obstacle to the range of artillery has been removed within a distance of 2000 yards from the glacis. In this case the 1st parallel is established at 1200 yards. If advantage can be taken of the ground, of course the parallel will approach nearer to the works. Boyaux of communications are made with the places of arms and depots in the rear.

##### *2d period.*

The first batteries are commenced. For what object? Not for ricochet. All parts of the work are concealed from ricochet. These batteries are to be constructed for mortars, and placed in the best positions to throw shells against the blindage of the towers, cavaliers and curtains. These batteries are vigorously pushed forward, and the boyaux of communication in advance of the 1st parallel are commenced.

#### DEFENCE.

##### *1st period.*

The garrison have no preliminary arrangement to make. The work is amply supplied with all the materials of defence, and is properly garrisoned. The guns are already in position. A proportion of duplicate carriages, chassis, &c., are placed in safe and convenient positions. Ammunition is prepared. No advanced posts are to be looked to. There are no arrangements to be made for sorties. There are no auxiliary works in covert ways to be provided for. The exterior defensive mines, being made permanent, are confined to the capitals of the high glacis. If others be deemed necessary, they may now be commenced, looking to the entire envelopment the high and low glacis. Order and vigilance reign throughout the works.

No artillery is discharged against reconnoitering parties. Why uselessly aim at the lives of the gallant Engineers? Let them know the strength of the works. There would be no objection to furnish them a plan of the works. They might advise the abandonment of the siege. At all events, they should not be fired at in the discharge of their otherwise dangerous duties.

When the 1st parallel is begun, let the siegers be saluted with a general volley from the 212 pdr. columbiads and all the mortars from the front of attack.

##### *2d period.*

The garrison fire upon these batteries by volleys of 5 guns, with full charges and solid shot of 212 pounds, and with short charges and hollow shot of the same calibre.

The mortars are also directed upon the batteries and trenches, and the enemy's camp in the rear. Thus every battery of the sieger is counter-battered from the work.

The defensive mines are pushed forward under the glacis.

*3d period.*

The mortar batteries are pushed forward, though the works are often interrupted by the heavy fire of the place. The boyaux advance toward the 2d parallel. In the course of the night, the mortars and munitions are brought to position wherever the batteries are sufficiently advanced to receive them. In the course of the day the fire from the mortars commence, and the bombardment of the place begins.

*4th period.*

The siegers, notwithstanding the interruption from the fire of the place the preceding day, persist in their approach. The boyaux have been vigorously pushed forward during the night, toward the 2d parallel. Finding that the fire has ceased from the works, they employ larger forces in the trenches. They commence the 2d parallel at 600 yards from the place. The bombardment is kept up from all the batteries of the 1st parallel.

The 2d parallel and the boyaux already in advance, are vigorously prosecuted.

*5th period.*

The batteries are commenced in advance of the 2d parallel, and are intended for 24 pounders and mortars.

The bombardment is kept up from the batteries of the 1st parallel.

*6th period.*

The batteries of the 2d parallel are complete. The guns and munitions placed in position. The fire of the 24 pdrs. is opened *à plein fouet* against the blindage of the towers and cavaliers. The mortars at this range also commence their fire, which is directed against the blindage at an angle of 30°.

The bombardment from the 1st parallel is continued.

The batteries of the 24 pounders are silenced. The guns are dismounted and the epaulement torn to pieces.

The siegers in vain endeavor to reconstruct the batteries against the terrible fire of the place. If the sieger's army were composed of the hosts of Xerxes, it could not stand against much less advance in the face of this iron hail storm.

*7th period.*

The work of the trenches is discontinued. A bombardment is kept up from all the mortar batteries, which, being sunk below the level of the country, have thus far escaped the terrific fire of the columbiads.

*3d period.*

A heavy fire is continued upon the batteries and trenches. The advancing boyaux attract a portion of this fire.

The garrison is engaged in completing the defensive mines and in repairing the damages done by the bombardment.

During this period a constant and heavy fire has been kept up by the 212 pounders and mortars, with a view to the rapid destruction of the enemy's works, and in order to show that so long as these terrible engines remain in position the trenches cannot be advanced unless at an immense loss to the siegers.

*4th period.*

The garrison permit the advance of the sieger's works without opposition. They repair the damages from the bombardment and they proceed with the mines.

*5th period.*

The garrison reserve their fire. They repair damages of the bombardment. The work of the mines proceeds.

*6th period.*

The garrison still reserve their fire. They repair damages.

At the instant the batteries of the 2d parallel open their fire, the whole grand artillery of the front of attack is directed against the sieger's works. Volleys are rapidly fired by divisions of 5 guns of 212 pounders solid and hollow shot *à plein fouet* upon the sieger's batteries in which his 24 pounders are mounted.

These batteries are destroyed. They cannot be reconstructed. The mortars from all parts of the work are in full play at various angles and directed principally against the 1st and 2d parallels. The sieger's works are swept from right to left by shells and shots from the 212 pdr. columbiads, rolling, bounding and bursting in every direction.

The garrison repair damages from the bombardment.

*7th period.*

Hollow shot are thrown with short charges and slight elevation from the columbiads, and made to explode in the mouths of the mortar batteries of the siegers. With the range and charge well adjusted, this fire

The ricochet fire from those pieces begins to be felt.

At this stage of the siege, at 600 yards distant from the place, the sieger's operations are arrested and confined to the bombardment of the place.

If the ground is favorable he may determine to proceed *sous terre*, or, he may determine to envelope more fronts of the work and increase and continue the bombardment.

The loss of the siegers is very great.

may be made very effective, especially upon the batteries established at 600 yards.

The effects are perceived on the sieger's works.

The garrison having enveloped the whole glacis with defensive mines, push out others in advance and are ready to meet the sieger's attack by mines.

The garrison, protected by ample bombproofs, have sustained but little loss. Some guns have been dismounted by shells and shots passing into the embrasures. These have been remounted and other damages repaired, and the work, with ample materials, is again in perfect condition to resist an attack.

The bombardment and cannonade continue against the sieger's works.

The arrangement of other parts of the project is indicated in the plan and sections, and require but brief explanation. The high glacis opposite the towers is designed to cover as much of the faces of towers as possible, in order to save the expense of the wrought iron clothing proposed for the exposed parts of these walls. At the same time, it affords a high gallery under the counterscarp salient, in which two tiers of musquetry and one tier for cannonry are advantageously obtained. (See plates 1st and 2d.)

The substitution of earth for masonry, in the scarp of curtain, was decided upon after much reflection. The advantages are greater than the disadvantages. Its advantages are economy and great capacity of the earth rampart to resist the effects of cannonry. Its disadvantages are that it offers greater facility to the surprisal of a place. The advantages are positive and exist without qualification. The disadvantages may be remedied. 1st. By the increased vigilance of the garrison of the work when invested and under siege. 2d. By the reflection of strong and constant lights from the salient counterscarp galleries, during the night, upon the low glacis by which any movement toward the descent of the counterscarp may be perceived. 3d. By doubly fraising the exterior slope of rampart of curtains, the fraises being concealed from ricochet shot. If Nos. 1 and 2, through negligence, prove of no effect, the assailants, on gaining the ditch and before they could ascend the exterior slope of rampart, would be obliged to cut down the first row of fraises. In the mean time, and before they could reach the second row of fraises, the garrison, taking the alarm, would discharge from the towers and galleries under counterscarp, so murderous a fire of cannonry and musketry, as to compel the retreat or surrender of the assailants. Ditches full of water when frozen over would expose the work to surprisal. In this case the counterscarp opposite curtain should be increased in height. With the crest of counterscarp ten feet above the level of water in the ditch, and heavy cheveaux de frise placed on the ice at the foot of rampart, flanked by cannonry and musketry *that cannot be destroyed*; it is thought that the necessary security against surprisal would be obtained in the new trace. There is a great difference in attempting to carry a work by a coup de main, when its guns are in position, and when the guns in its flanks have been destroyed by ricochet. Every possible precaution should be taken against surprisal. Fraises should be placed on the upper parapet, and barriers placed across the terreplein of lower rampart at the salients of cavaliers. So that, if the assaulters gained possession of the lower parapet, they would be obliged

to overcome these new obstacles, exposed to a deadly fire from the towers and cavaliers.

The foregoing considerations in respect of scarps of earth and masonry, involve no principles of the new trace, and if the reasons for the adoption of the earth scarp are deemed insufficient, a scarp of masonry may be substituted.

A counterscarp gallery in front of curtain is not provided, though its loop holes for musketry would afford a strong reverse fire upon the exterior slope of rampart, from its foot to its crest. But the courtine is so well flanked as not to require this additional defence, and economy is therefore consulted in dispensing with this gallery. It should be observed that the towers may be pierced for musketry between the iron bars.

The flanks of cavaliers are exposed to a ricochet fire, although the distance at which the batteries must be placed would render this fire of doubtful effect; yet, as the guns placed at R in those flanks, and which rake the coupé of the high glacis, are very important ones, it is suggested that bomb proof shelters may be constructed over them without interfering with the service of other guns. Following up the idea of making shelters proof against ricochet to the cavaliers, a plan has been made for similar structures over five guns in each tower. The arrangement of concentric circles in blindage and platforms, and the beams of each laid in radii from a common centre, gives great strength to the whole structure of the towers. A shot fired point blank and perpendicularly to the curves of towers, is in the line of the greatest resistance, i. e. of the diameter of towers. It has been endeavored to arrange these shelters so as not to interfere with the traverse of a gun at  $120^{\circ}$ . The plan of the embrasure enables this to be done. The gorge and end of the shelters are left open, which, together with the ventilation afforded by the embrasures, will permit the smoke to pass rapidly off. The ventilation of the second and third tiers will be secured by openings made in the scarp and between the iron bars of towers; many of which openings will be used as loop-holes for musketry. (See plate 3d, figs. 1, 2, 3, 4.)

The blindage arranged for the upper parapet differs from that designed for the towers and cavaliers. It covers more than half the guns in position in the curtain and in connection with the cavaliers, it protects the remaining guns from enfilade and ricochet. In construction of all the blindage or shelters described above wood must be used, for masonry takes up too much room. The objection to wood on account of decay is serious; but if the wood be of *good quality* and sheltered from the weather it will last a long time, some centuries. Being covered and saturated with mastic where it enters the earth, or comes in contact with it, its preservation will be insured. (See plate 2d, figs. 1, 2, 3, 4.)

Defensive mines may be added to the permanent construction without leaving their hasty arrangement to the time of expected or actual investment of the work. They are not expensive and therefore justify what is considered an extreme precaution, with a view to the moral effect, by increasing hors de place the idea of the great strength of the defence. These mines should be placed under the high glacis; along the curtains; and under the cavaliers. The object of mines under cavaliers being to destroy those works when taken, by which the parapets and terrepleins of curtains would be better commanded by the towers.

The communications are easy and the circulation ample within the

works. The main entrance is in one of the angles of the flanks and passes under the rampart and cavaliers to the parade. The ditch is crossed by a bridge at the same point, which communicates with the low glacis, in front of a gun casemate under high glacis. A passage is opened under the cavaliers and enters the lower story of towers, whence, if the ground will admit it is continued under the ditch to the galleries of counterscarp in the salient. If as at Fort Pickens, the bottom of the ditch is on a level with high water, posterns in the towers and counterscarp afford the necessary communications. Passages under the upper parapet give the communication between the lower and upper terrepleins of rampart of curtains, and passages ascend to the cavaliers being carried under the parapets. Capacious ramps ascending from the parade communicate with the terrepleins of the work; and steps of masonry ascend to the cavaliers. Magazines are placed in the lower story of towers. If bomb proof store-rooms are required to a greater extent than are supplied in the towers, then casemates can be constructed under the cavaliers. The soldiers' barracks are two stories high, made bomb proof, and are each designed for 1000 men. With the addition of a third story, each range will hold 1500 men.

The cumulation of works may be thought to involve more costly construction than exterior works after the present system; but accurate estimates show that this is not the case. Economy in construction is important, but its consideration ought not to compromise the safety of a work. For if it be shown that at any point where works are necessary to the defence of a great city, a naval place of arms or of great strategic positions, either inland as at Coblenz, or on the sea-coast as at Pensacola, Gibraltar or Tortugas, an expenditure of millions will make it impregnable whilst that of hundreds of thousands will only make it tenable for a few days or months, then the authorities of a country would lack wisdom if they limited the expenditure to hundreds of thousands.

The new trace is compared with Fort Pickens, one of the works constructed for the defence of the harbour of Pensacola. Though in the matter of economy as well as in others, the parallel does not always appear, yet the divergence is not so great that reliable results may not be had. The cost of Fort Pickens is stated at \$750,000. The cost of constructing a work on the principles of the new trace, allowing \$200,000 for the iron clothing of the walls of towers, will not exceed \$750,000.

Fort Pickens is armed with 240 guns, of all classes, the largest of which are, besides mortars, 42 pounders. 300 guns can be conveniently placed in position in the plan of the new trace, but 250 are only designed for it, of which 112 would consist of 212 pounder columbiads. A square figure would not be so well adapted to the defence of the position occupied by Fort Pickens as that of a parallelogram. This figure would increase largely the capacity for the channel defence and the strength of the front of attack on the land side.

The trace shows a front of 240 yards, measured on the salients of tower bastions on the exterior side. The figure is a square, and the four fronts measure 960 yards. The entire development of the lower parapet of curtain is 788 yards; including the upper parapet of the same it is 1268 yards; including the parapet of cavaliers it is 1532 yards; and including the towers it is 1812 yards. Fort Pickens has a frontage of 774 yards. The entire development of its interior crest of parapet is 926 yards, which is

only 136 yards more than that of the lower parapet of the new trace, whilst it is 344 yards less than that of the upper and lower parapets, and 888 yards less than the entire development of the new trace.

The comparison thus briefly made of a work constructed on the principles of the new trace and of Fort Pickens, shows an equality of cost of construction, a greater development of the interior crest of parapet of the former, and consequently a greater capacity for defence than that afforded by the latter, whilst the faces and flanks being made proof against breaching and counter batteries, and the guns in the barbette batteries protected against ricochet, exhibits manifestly the superiority of the new trace over Fort Pickens, or any other work of the modern system whose faces and flanks and curtains are exposed to ricochet, and whose walls can be breached and the work itself reduced in a given time.

Reliance being had on the body of the place and its cumulative works for a complete defence, the covert way and all advanced works are dispensed with, so that the fights of the covert way and sorties so uselessly destructive of life, are no longer required. The garrison stand behind shot-proof breastworks, and defend them with but little annoyance from the assaulters. The siegers cannot make a lodgement on the glacis in face of the tremendous cannonry and musketry that every instant prevents the construction of breaching and counter-batteries. It is doubtful even if the second parallel can be maintained at 600 yards. The enemy could only hope to succeed *sous terre*. But if as at Fort Pickens the ground in advance of the glacis is cut down to the level of high water, or if the surface be rocky as at Key West, or if the country can be inundated at pleasure no mining operations can be carried on. If the ground were favorable to mining then the defensive mines must be resorted to.

It is proposed to garnish the barbette battery of the towers, cavaliers and upper parapets of curtains with 12 inch columbiads, which can fire solid or hollow shots: 28 of these guns are supplied to each front. The casemates of towers and reverse fires under salients of counter scarp will receive carronades and howitzers. Howitzers and mortars are placed in the lower terreplein of curtain. The front looking towards the channel approaches would receive some modification in the armament designed for the land front so as to afford a maximum fire. The blindage of the upper parapet would be extended so as to cover the entire length of the curtain, and a blindage would be supplied to the lower parapet of curtain. In no other respects is it intended to modify the arrangements of the channel fronts, except perhaps to construct gun casemates *in the right and left faces of the high glacis*.

The command over the country by the cavaliers and towers, and by the upper or second parapet to curtain affords great facility of defence and resistance to the operations of a siege; and when these elevated batteries discharge shot of 212 pounds, is it possible that the sieger can continue his approach, supported by siege guns of 12, 18 and 24 pounders?

Thus it has been shown that a great change is likely to take place in the system of fortifications—a change effected for the most part by the introduction of a single material into the construction of certain parts of a work—and those the vital parts. Neither the breach could be prevented nor the blindage arranged by which ricochet is rendered ineffectual without the use of iron. To iron then is due in a great degree the important improvement in the art of defence, herein treated of, and its use must be



adopted in future constructions, from the Martello Tower with its wrought-iron machicoulis up to the fortress of the first class. The cumulative system of works also recommends itself to the Engineer as possessing decided advantages in the defence of places, over the arrangement of the present system.

It is thought that the solution of the problem stated at the head of this memoir no longer remains to be found, and if it be accepted by the Engineer, the defence is at once decided to be superior to the attack of places. To a military man this will be a matter of deep interest, whilst the statesman cannot fail to perceive the important change it is destined to make in international relations. Then indeed will fortifications be able to protect the weak against the strong, and bloody strifes amongst nations be greatly diminished.

WM. H. CHASE,

Chasefield, near Pensacola, }  
September 1845. }











